



Centers for Disease Control and Prevention  
National Center for Environmental Health  
Vessel Sanitation Program

## Health Practices on Cruise Ships: Training for Employees Transcript

### **Swimming Pools and Whirlpool Spas**

The Centers for Disease Control and Prevention's Vessel Sanitation Program is proud to bring you the following session: Swimming Pools and Whirlpool Spas. While this presentation is primarily intended for cruise vessels under the jurisdiction of the Vessel Sanitation Program, it may also be used by anyone who is interested in the topic. This session should not be used as a replacement for existing interactive training, but should be used as an adjunct to a comprehensive training program.

Learning objectives: list the types of recreational water illnesses and the pathogens that cause them, list the ways in which a pool can be operated to control these pathogens, list the parameters that should be monitored and controlled to ensure water quality in pools and whirlpool spas, list the safety features required for lifesaving at swimming pools.

Hazards and recreational water illnesses, RWIs, associated with recreational water. These include injuries, gastrointestinal illnesses, respiratory illnesses, contact skin illnesses, ear infections, eye infections, and wound infections.

Recreational water use is associated with a spectrum of illnesses in treated aquatic venues: diarrheal illness-- *Cryptosporidium*, toxigenic *E. coli*, *Giardia*, *Shigella*, and noroviruses; skin infections-- *Pseudomonas dermatitis* and folliculitis; outer ear and eye infections-- *Pseudomonas*, adenoviruses; and respiratory-- *Legionella*.

RWI outbreaks, United States, 1993 to 2002, diarrhea in treated venues. This slide shows us that 65.6% of the outbreaks were the result of *Cryptosporidium*, which is chlorine-resistant. The remaining outbreaks were associated with pathogens which are chlorine sensitive and are a result of poor pool maintenance.

Types of pools. On vessels, we have large swimming pools and wading and splash pools which are normally associated with kids' activities. Swimming pool operation. There are two types of pool operation onboard the vessels-- flow-through seawater pools and recirculated water pools. Flow-through seawater pools. The flow-through seawater pools can be switched to recirculating mode as the vessel approaches within the 12-mile limit.

Flow-through mode. While operating in the flow-through mode, no halogenation treatment is required, because the water is consistently turned over and does not reside in the pool long enough to be treated.



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**Recirculated pools.** Recirculated pools can be operated any time, anywhere. This is because they are filtered and halogenated to treat for pathogenic organisms. Recirculated swimming pool filtration requires the measuring of pressure differentials to determine the effectiveness of the filtration system. These systems must be backwashed or cleaned, they must be inspected regularly, and filters must be changed every six months. Recirculated swimming pool filtration. Most of the things that you would do in maintaining the swimming pool filters are based on manufacturer recommendations. These include pressure differential, backwash or cleaning of the filter media, inspection frequency, and changing of the filters or the filter media.

**Recirculated pool water quality.** When considering pool water quality, the following items must be considered: filtration and flow rates, pH, alkalinity, clarity, and the water source, whether it's potable water or seawater. Recirculated pools, halogenation. The halogenation level on recirculated pools must be monitored every four hours and must be maintained between one and five parts per million for both bromine and chlorine.

**Swimming pool safety equipment** includes the appropriate flotation device with a rope attached. This rope should be 50 feet in length or one and a half times the width of the pool. A shepherd's hook should also be available in an easily seen location and should be easily retrievable. Depth markers should be installed on the pool where they are visible from the deck and in the pool and should be in a unit of measure that are understood by the people utilizing the vessel.

**Typical pool safety signs.** This slide shows some typical shoreside signs. When developing signs for your pool, you want to consider whether or not a lifeguard is going to be on duty, information about whether or not glass is allowed, which you would not want to have glass allowed in the pool for safety reasons, no running, and other items you might feel are important.

**Public whirlpool spas. What's in the air?**

**What is Legionella?** Legionella is a microbacterium, Legionella. It's widely distributed in natural and manmade water systems, can be found in freshwater systems, and it's an intracellular parasite of free-living amoeba. Legionellosis. Two forms of this illness exist: Pontiac fever, which is the milder flulike symptom with an incubation period of two to 48 hours, and legionellosis, which is a severe pneumonia with an incubation period of two to 14 days.

**Historical perspective on Legionella.** In 1976, there was an American Legion convention in Philadelphia. There were 182 cases of pneumonia with 29 deaths. This outbreak was associated with a new bacteria not previously linked to human illness. This new bacterium was named Legionella pneumophila. The bacteria was found growing in the cooling tower and was then introduced in the hotel's heating, ventilation, and air



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conditioning system. Mechanisms of Legionella transmission. The Legionella bacterium can be introduced through showers, whirlpools, humidifiers, respiratory therapy equipment, faucets, or cooling towers.

Key points regarding transmission. There is no person-to-person transmission. It is found in natural environments such as lakes and rivers, but they do not have sufficient quantities of Legionella to cause transmission. Many spas may have Legionella, but levels are not high enough to cause disease. You don't need to get in the water to get Legionella. You can just breathe the air in the vicinity containing the droplet particles.

Whirlpool water quality. When considering whirlpool water quality, we need to look at clarity, alkalinity, pH, filtration and flow rates, halogen residual, and whether or not the water is changed daily. Spa pools are exempt from this requirement for the daily water change.

Halogen residuals and pH. As we can see from this slide, the halogenation residuals for whirlpools and whirlpool spas is different from that of swimming pools. Chlorine halogenation is required between three to ten parts per million. Bromine halogenation is four to ten parts per million. And pH must be maintained between 7.2 and 7.8. Halogen monitoring. Halogen monitoring-- halogens should be measured and recorded hourly or, if an automated analyzer is used, calibrated and checked and recorded daily.  $TC = FC + CC$ . TC means total chlorine, FC means free chlorine, and CC means combined chlorine. Free chlorine is the active disinfectant available. Combined chlorine is the chlorine bound with ammonia or organic compounds within the water. Combined chlorine should be in the range of 0.2 to 0.5 parts per million.

Break point chlorination. Break point chlorination is adding enough chlorine to eliminate problems associated with combined chlorine. It does not affect the organic combined chlorines, and it requires ten times the amount of combined chlorine to reach break point chlorination.

Protens Hydrogen, or pH. pH is the negative log of the hydrogen ion concentration. The ideal pH for pool chemistry is 7.2 to 7.4 Tears have a pH of 7.5. The ideal pH for bather comfort is 7.4 to 7.6 The acceptable pH for pools and spas is 7.2 to 7.8. pH range versus chlorine effectiveness.

pH range versus chlorine effectiveness-- our pH range is 7.2 to 7.8. At pH 7.2, 80% hypochlorous acid is formed, plus 20% hypochlorite ion. It should be noted that hypochlorous acid is the more effective disinfectant. At a pH of 8.0, 20% hypochlorous acid is formed, plus 80% hypochlorite ion. Therefore it requires more time for the disinfectant to work at this pH.



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Total alkalinity, 80 to 120 parts per million. Total alkalinity is the measure of the water's ability to resist changes in pH, bicarbonate plus carbonate plus hydroxide. At low total alkalinity, the pH is unstable, and therefore you would have dramatic jumps in pH from low to high. Add sodium bicarbonate to adjust a low alkalinity. High total alkalinity. At high total alkalinity, pH is very stable, and it becomes difficult to adjust the pH either up or down. To correct this problem, you'll want to add an acid such as muriatic acid or sodium bisulfate.

Total dissolved solids, TDS. TDS is an indicator of the soluble matter in the water. The longer the water is kept, the higher the TDS level. A high TDS level can mean a high organic contamination level. The TDS level should never increase more than 1,500 parts per million higher than the startup level of the pool.

Cartridge filters. You're required to have at least one replacement cartridge filter. The filter should be backwashed or cleaned as recommended by the manufacturer, and they should be inspected weekly. Granular filters. Granular filters should be backwashed daily, not based on pressure differentials. They should be inspected monthly, a sedimentation test must be performed, and the media must be replaced every six months.

Backwashing filters. Backwashing filters can have an automatic startup, but not an automatic stop. The operator must view the port and ensure that the water is clear before the backwash cycle is stopped. Monthly inspection and sedimentation test. First perform the backwash of the filter, then stop the pumps. Drain water from the filter, open the port, inspect the filter for cracks, holes, or mounds, collect a core sample using an appropriate tool, place the filter media in a clear jar with water, shake and let stand for 30 minutes, and then check for excessive organic material. The following slides will show a filter media test.

This slide shows the filter housing opening. Drain water and filter housing and inspect uniformity of sand, again checking for holes, mounds, or channels. Collect a core sample of filter media. Place the core sample in a clear jar, add water, and shake. Leave for 30 minutes to settle.

Daily shock treatment. Raise the bromine or chlorine halogen residual to ten parts per million, circulate for one hour, discharge to waste. Maintain a record of the daily shock treatment. Note that seawater whirlpools are exempt because *Legionella* does not grow well in seawater. Whirlpool signs and markings. Whirlpool signs should be available in easily viewable locations that indicate the risks associated with whirlpools to precautions to take. At a minimum, the signs should warn immunocompromised individuals.

Temperature setting. The maximum temperature setting should be 40 degrees Centigrade or 104 degrees Fahrenheit, and the heater should have an automatic shutoff device so that the temperature does not exceed this limit.



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Pools and whirlpools. Pools and whirlpools should be equipped with antientrapment or antivortex drain covers.

Antientrapment drain covers. The covers should be stamped with approval, organization, and maximum flow rates. If the cover does not have a stamp, a letter attesting to the cover's meeting the ASME/ANSI standard or equivalent can be substituted for the stamp. It's not just the main drains that need to be antientrapment. As we can see in this slide, the main drain has an antientrapment cover. However, the side has a broken or missing piece which could result in an entrapment hazard. Improperly installed, missing fasteners, or damaged covers, like the one shown here, are not antientrapment, even if stamped or certified. Is this installation okay? As we can see from this slide, an antientrapment drain cover has been installed on an existing drain, but this drain cover is too small.

Multiple drain systems. In lieu of antientrapment drain covers, a multiple drain system can be installed, such as the dual drain system shown here. The dual drain systems must be a minimum of three feet apart, and note that no valves are permitted between the drain covers and the T. Channel drain system. A channel drain system can also be used in lieu of antientrapment drain system. The grate-type cover would be attached to the entire channel.

Pools and whirlpools. Every pool and whirlpool is required to have a fecal accident procedure. An example of a fecal accident procedure can be found in the 2005 Vessel Sanitation Program operations manual.

Diaper restrictions. Children in diapers or who are not toilet trained are not permitted in swimming pools or whirlpool spas.

Fecal accident procedure. When developing your fecal accident procedure, it is important to consider the CT value of organisms. In this instance, CT equals parts per million times minutes where C is the concentration of the halogen in parts per million and T is the time in minutes. For formed stools, the CT value must be 45 or greater. For loose stools such as diarrhea, the CT value must be at 9,600. This is due to the *Cryptosporidium* organism, which is chlorine resistant and may be associated with diarrhea. This concludes our session on swimming pools and whirlpool spas.

Resources and references. For further information, please visit the following Web sites: the Centers for Disease Control and Prevention at [www.cdc.gov](http://www.cdc.gov), the Environmental Protection Agency at [www.epa.gov](http://www.epa.gov), or the Consumer Product Safety Commission at [www.cpsc.org](http://www.cpsc.org).